

From: [Jen Mott](#)
To: [Dana Bayuk](#)
Cc: [Pradeep Mugunthan](#); [Binglei Gong](#); [Myron Burr \(myron.burr@siltronic.com\)](#); [Rachel Melissa \(RMelissa@pearllegalgroup.com\)](#); [Cindy Bartlett \(CBartlett@Geosyntec.com\)](#); [Dan Hafley](#); [Rob Ede; poulsen.mike@deq.state.or.us](#); [Kelly Titkemeier \(kittkemeier@maulfoster.com\)](#); [Bruce Marvin \(BMarvin@Geosyntec.com\)](#); [Sheldrake, Sean](#); [Henning Larsen](#); [Mary Benzinger \(mbenzinger@maulfoster.com\)](#); [Lance Peterson \(PetersonLE@cdmsmith.com\)](#); [Sarah Riddle](#); ["Mike Murray"](#); [Scott Coffey](#); [DeMaria, Eva](#); [Matt Gamache \(gamachem@cdmsmith.com\)](#); [James Peale](#); [Ben Hung](#); [Carl Stivers](#); [John Edwards](#); [Patty Dost](#); [John Renda](#); [Mike Riley](#); [Miao Zhang](#); [Vipul Srivastava \(VSrivastava@Geosyntec.com\)](#); [Madi Novak](#); [Bob Wyatt; peterson.Jennifer@deq.state.or.us](#); [Jen Mott](#)
Subject: RE: Gasco: Call to Discuss Groundwater Modeling Figures - Follow-up on Model-predicted Groundwater Elevations in the LNG Basin
Date: Friday, August 19, 2016 1:12:26 PM
Attachments: [Figures 1 and 2.pdf](#)

Dana,

This email is provided on behalf of Pradeep.

Dana,

During the August 2, 2016 conference call DEQ noted that the model-predicted groundwater elevation contours in the Fill WBZ from the Feb 28, 2016 and Mar 11, 2016 steady state simulation runs were above the ground surface in the LNG basin. We reviewed the ground surface elevation data in the LNG basin and compared it to model-predicted groundwater levels for both dates when contours were presented. Figures 1 and 2 (attached to this e-mail) show the ground surface elevation contours overlaid on groundwater elevations predicted in the Feb 28 and Mar 11 steady state simulations respectively. The model predicted groundwater elevations are shown as filled contours with colors binned to represent the elevation intervals. The ground surface elevation contours show that the bottom of the basin is predominantly between 19 to 20 feet (COP datum). Note the area of higher ground surface contours at the location of the LNG tank. Figures 1 and 2 show that model-predicted groundwater elevations are below the tank basin bottom everywhere except the southwestern corner of the basin. The higher model-predicted groundwater elevations in the southwest corner of the basin are consistent with the predominant Fill WBZ groundwater gradient which is from Highway 30 to the river. Moreover, model-predicted groundwater inflows into the LNG basin (of 13-14 gpm shown in the June 29, 2016 modeling workshop) were consistent with the estimated long-term average groundwater inflow to the LNG basin of approximately 10 gpm. Furthermore, model-predicted groundwater elevations in Fill WBZ monitoring well MW-10-25 near the LNG basin (where a transducer was installed this year) showed that the model provided a good fit to observed groundwater elevations (average residual of 0.4 ft – shown on Slide 79 of the June 29, 2016 modeling workshop presentation). Based on the evidence from the ground surface elevation data, model-predicted flows to the LNG basin drain boundary and model-data comparisons at Fill WBZ well MW-10-25; we conclude that the model-predicted contours in the LNG basin shown during the August 2, 2016 conference call are appropriate.

We look forward to discussing the information presented in this e-mail during our next conference call. During that call we plan to discuss the scope of model sensitivity analysis and deep lower alluvium particle tracking simulations.

Thanks.

Pradeep

Thank you,
Jen Mott ☺
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jmott@anchorqea.com
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503-972-5014

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From: Jen Mott

Sent: Wednesday, August 10, 2016 3:16 PM

To: Bruce Marvin (BMarvin@Geosyntec.com) <BMarvin@Geosyntec.com>; Dana Bayuk <BAYUK.Dana@deq.state.or.us>; Cindy Bartlett (CBartlett@Geosyntec.com) <CBartlett@Geosyntec.com>; Dan Hafley <HAFLEY.Dan@deq.state.or.us>; Henning Larsen <larsen.henning@deq.state.or.us>; Jennifer Peterson (peterson.jennifer@deq.state.or.us) <peterson.jennifer@deq.state.or.us>; Karen Kosiarek (KKosiarek@geosyntec.com) <KKosiarek@geosyntec.com>; Mike Poulsen (poulsen.mike@deq.state.or.us) <poulsen.mike@deq.state.or.us>; Sarah Riddle <sriddle@pearllegalgroup.com>; Eva DeMaria (DeMaria.Eva@epa.gov) <DeMaria.Eva@epa.gov>; John Renda <jrenda@anchorqea.com>; Bob Wyatt <rjw@nwnatural.com>; Patty Dost <pdost@pearllegalgroup.com>; John Edwards <jedwards@anchorqea.com>; Carl Stivers <cstivers@anchorqea.com>; Ben Hung <bhung@anchorqea.com>; Rob Ede <robe@hahnenv.com>; Rachel Melissa (RMelissa@pearllegalgroup.com) <RMelissa@pearllegalgroup.com>; Sean Sheldrake <sheldrake.sean@epa.gov>; Scott Coffey (coffeyse@cdmsmith.com) <coffeyse@cdmsmith.com>; Lance Peterson (PetersonLE@cdmsmith.com) <PetersonLE@cdmsmith.com>; James Peale <jpeale@maulfoster.com>; Kelly Titkemeier (ktitkemeier@maulfoster.com) <ktitkemeier@maulfoster.com>; Madi Novak <mnovak@maulfoster.com>; Mary Benzinger (mbenzinger@maulfoster.com) <mbenzinger@maulfoster.com>; 'Mike Murray' <mmurray@maulfoster.com>; Myron Burr (myron.burr@siltronic.com) <myron.burr@siltronic.com>

Cc: Jen Mott <jmott@anchorqea.com>; Pradeep Mugunthan <pmugunthan@anchorqea.com>; Binglei Gong <bgong@anchorqea.com>; Matt Gamache (gamachem@cdmsmith.com) <gamachem@cdmsmith.com>; Mike Riley <mriley@anchorqea.com>; Miao Zhang <mzhang@anchorqea.com>

Subject: FW: Gasco: Call to Discuss Groundwater Modeling Figures

For your information, please see below and attached.

Thank you,
Jen Mott ☺

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503-972-5014

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From: Pradeep Mugunthan
Sent: Wednesday, August 10, 2016 2:50 PM
To: BAYUK Dana <dana.bayuk@state.or.us>
Cc: Binglei Gong <bgong@anchorage.com>; Ben Hung <bhung@anchorage.com>; 'Scott Coffey' (<coffeyse@cdmsmith.com>)' <coffeyse@cdmsmith.com>; 'Eva DeMaria' (<DeMaria.Eva@epa.gov>)' <demaria.eva@epa.gov>; 'Matt Gamache' (<gamachem@cdmsmith.com>)' <gamachem@cdmsmith.com>; LARSEN Henning <henning.larsen@state.or.us>; John Edwards <jedwards@anchorage.com>; Jen Mott <jmott@anchorage.com>; James Peale <jpeale@maulfoster.com>; John Renda <jrenda@anchorage.com>; 'Mike Murray' <mmurray@maulfoster.com>; Madi Novak <mnovak@maulfoster.com>; Mike Riley <mriley@anchorage.com>; Miao Zhang <mzhang@anchorage.com>; 'Lance Peterson' (<PetersonLE@cdmsmith.com>)' <petersonle@cdmsmith.com>; Sean Sheldrake <sheldrake.sean@epa.gov>
Subject: RE: Gasco: Call to Discuss Groundwater Modeling Figures

Hello Dana,

Thanks for the approval on model calibration. As discussed this morning I have attached an extract from a standard reference (*Fetter, C.W., 2000, Applied Hydrogeology, fourth edition, Prentice Hall*) to support the use of Cooper-Jacob method for analysis of single-well test data in the Fill WBZ. The relevant text that addresses partial penetration and well skin effect is shown highlighted. Should you have further questions or need clarification, (b) (6)

(b) (6) and would be able to address any questions.

Thanks.
Pradeep

Pradeep Mugunthan, Ph.D., P.E.

ANCHOR QEA, LLC
D 773-697-7973 (please note new phone number)
M 607-351-3494

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From: BAYUK Dana [<mailto:dana.bayuk@state.or.us>]

Sent: Tuesday, August 09, 2016 1:16 PM

To: Pradeep Mugunthan <pmugunthan@anchoragea.com>

Cc: Binglei Gong <bgong@anchoragea.com>; Ben Hung <bhung@anchoragea.com>; 'Scott Coffey' (coffeyse@cdmsmith.com)' <coffeyse@cdmsmith.com>; 'Eva DeMaria' (DeMaria.Eva@epa.gov)' <demaria.eva@epa.gov>; 'Matt Gamache' (gamachem@cdmsmith.com)' <gamachem@cdmsmith.com>; LARSEN Henning <henning.larsen@state.or.us>; John Edwards <jedwards@anchoragea.com>; Jen Mott <jmott@anchoragea.com>; James Peale <jpeale@maulfoster.com>; John Renda <jrenda@anchoragea.com>; 'Mike Murray' <mmurray@maulfoster.com>; Madi Novak <mnovak@maulfoster.com>; Mike Riley <mriley@anchoragea.com>; Miao Zhang <mzhang@anchoragea.com>; 'Lance Peterson' (PetersonLE@cdmsmith.com)' <petersonle@cdmsmith.com>; Sean Sheldrake <sheldrake.sean@epa.gov>

Subject: RE: Gasco: Call to Discuss Groundwater Modeling Figures

Good morning Pradeep.

DEQ has reviewed the following items prepared by Anchor QEA, LLC (Anchor) for NW Natural: "Gasco Groundwater Modeling Workshop" presentation slides dated June 29, 2016 (6/29 slides); and Package of simulated equipotential contour maps and velocity vector figures provided by e-mail on July 20, 2016 (7/20 figures).

Anchor arranged the 6/29 workshop to present updates made to the groundwater model since the previous workshop on December 2, 2015 (12/2/15 workshop). The 6/29 workshop presented for the first time the results of calibrating the groundwater model based on DEQ and EPA comments provided during the 12/2/15 workshop and in subsequent correspondence exchanged following the workshop, including but not limited to DEQ's January 26 and May 27, 2016 e-mails.

In response to requests made during the 6/29 workshop, Anchor prepared the 7/20 figures which DEQ and EPA reviewed prior to a conference call with Anchor on August 2, 2016.

Based on our review of the 6/29 workshop presentation materials and the July 20th figures, DEQ: Acknowledges that modifications made to the groundwater model generally address DEQ's comments communicated to NW Natural during and subsequent to the 12/2/15 workshop; and Approves calibration with the following comments:

DEQ notes that the shoreline seepage boundary condition may limit the utility of future steady-state simulations and requests that the extent of this boundary condition be shown on figures in the future.

Simulated discharges from the LNG basin have increased from around 2 gpm to around 14 gpm, and DEQ requests that: 1) site data be used to confirm this value (e.g., compare to measured discharges from the LNG basin to the City POTW); and 2) this information be included in the model calibration portion of the modeling report.

DEQ requests that calibration documentation discuss how well the model matches head changes in

the Deep Lower Alluvium WBZ in response to extraction wells operating in the upper and lower Alluvium WBZs.

In addition to providing our comments on model calibration, DEQ notes that during the 8/2 conference call we indicated that simulated piezometric heads shown on certain 7/20 figures are above ground surface at the LNG basin. Anchor agreed to further evaluate DEQ's observation and follow-up by e-mail. DEQ requests that NW Natural's evaluation be provided on or before Friday August 19th.

Furthermore, NW Natural conducted single-well pumping tests at selected monitoring wells to evaluate the horizontal hydraulic conductivity of the Fill WBZ in uplands portions of the Gasco and Siltronic sites. The data was used to modify the hydraulic conductivity values in the groundwater model. During our review of the Single-Well Pumping Test Memorandum (see footnote), DEQ verbally requested a copy of the April 15, 2016 "C. Neville" e-mail cited in the document. According to the memo the e-mail supports NW Natural's use of the Cooper-Jacob method to interpret test data. DEQ requests a copy of the e-mail also be provided on or before Friday August 12th.

Based on the status of calibration, NW Natural will be moving forward with developing approaches for the vertical gradient and particle tracking analyses of the Deep Lower Alluvium WBZ, and the sensitivity analyses identified early in the model development process. As agreed during last Tuesday's (8/2) online meeting, a conference call will be arranged to discuss the scope and objectives of these modeling tasks before NW Natural proceeds with the work.

Pradeep, I'll check on the availability of the DEQ and EPA teams for a conference call in the next week or two to discuss these topics, and pass that information on to you. To avoid misunderstandings, DEQ's approval of NW Natural's evaluation of HC&C system transducer drift is also required before work on these tasks proceeds.

Feel free to contact me with questions regarding this e-mail and hope your day goes well.

Dana

Mr. Dana Bayuk
Cleanup Program Project Manager/Hydrogeologist
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Footnote. Anchor QEA, LLC, 2016, "Single Well Pumping Test in Fill Water Bearing Zone Monitoring Wells at the NW Natural Gasco Site," June 13, a technical memorandum prepared for NW Natural.

From: BAYUK Dana

Sent: Thursday, August 04, 2016 4:20 PM

To: 'Jen Mott'; Sean Sheldrake; Eva DeMaria (DeMaria.Eva@epa.gov); Lance Peterson (PetersonLE@cdmsmith.com); Scott Coffey (coffeyse@cdmsmith.com); Matt Gamache (gamachem@cdmsmith.com); LARSEN Henning; Ben Hung; Pradeep Mugunthan; Mike Riley; John Renda; John Edwards; Binglei Gong; Miao Zhang

Subject: RE: Gasco: Call to Discuss Groundwater Modeling Figures

Good afternoon Pradeep.

This e-mail follows up on Tuesday's online meeting to discuss groundwater modeling figures and the gradient analysis. During the meeting I let you know I'd get back to you on the date for DEQ to provide comments on model calibration and the workshop, including the modeling figures provided on July 20th.

I wanted to let you know that we anticipate having our comments to you on Monday August 8th.

Thanks again for arranging the August 2nd meeting. Everyone here considered the discussions productive.

Hope your day goes well.

Dana

Mr. Dana Bayuk
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-----Original Appointment-----

From: Jen Mott [<mailto:jmott@anchoragea.com>]

Sent: Monday, July 25, 2016 12:10 PM

To: Jen Mott; Sean Sheldrake; Eva DeMaria (DeMaria.Eva@epa.gov); BAYUK Dana; Lance Peterson (PetersonLE@cdmsmith.com); Scott Coffey (coffeyse@cdmsmith.com); Matt Gamache (gamachem@cdmsmith.com); LARSEN Henning; Ben Hung; Pradeep Mugunthan; Mike Riley; John

Renda; John Edwards; Binglei Gong; Miao Zhang; Sean Sheldrake

Subject: Gasco: Call to Discuss Groundwater Modeling Figures

When: Tuesday, August 02, 2016 12:30 PM-2:00 PM (UTC-08:00) Pacific Time (US & Canada).

Where: Conference Call and Web Meeting

Dana, Sean, Eva, Lance, Scott, Matt, Henning, Ben, Pradeep, Mike, John R., John E., Binglei, Miao –

A call has been scheduled to discuss the groundwater modeling figures provided to DEQ on July 20 and the gradient analysis approach.

Meeting information

Topic: Gasco: Call to Discuss Groundwater Modeling Figures

Date: Tuesday, August 2, 2016

Time: 12:30 pm, Pacific Daylight Time (San Francisco, GMT-07:00)

Meeting Number: 801 837 155

Meeting Password: (This meeting does not require a password.)

To start or join the online meeting

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Call-in toll number (US/Canada): (b) (6)

Access code (b) (6)

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Pradeep is the host for this meeting. Ben is the alternate host.